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Onion diseases and onion seed production

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ONION DISEASES AND ONION SEED PRODUCTION

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For a number of years onion diseases have been causing considerable injury in some sections of South Louisiana, being particularly severe in the Bayou Lafourche region, the most important onion section of the state. These troubles have been especially severe on the seed crop. Practically every year the seed crop has been reduced at least fifty per cent and often the reduction has been considerably more. The disease which seems to cause the most damage is the black stalk rot, though the onion mildew and some other troubles are also important.

The onion growers along Bayou Lafourche have long made a practice of growing their own seed. They have had to depend upon their own seed as they use almost exclusively a local variety, known as the Creole onion. Each grower usually has a few rows from which he obtains seed for his own planting. The onion is a comparatively heavy seed producer and it does not take a very large plot, even if the crop is reduced one-half by disease, to make sufficient seed to plant a considerable acreage. Consequently, in normal years with a normal acreage, the growers do not become seriously concerned with disease on their seed onions. However, it sometimes happens that when the price of onions goes up, resulting in an extension of the acreage planted, there is difficulty in obtaining sufficient seed. During the war, when onions went to a very high price, there was a heavy acreage increase and a very serious shortage of seed. Seed was in such demand that it went to as high as four dollars per pound. During that period some of the growers increased their acreage of seed onions to a considerable extent in order to furnish seed for the market, and for a period, were seriously concerned by the diseases. With the decline in price of onions since the war, the acreage has dropped back to normal, and the interest in the diseases has declined.

INVESTIGATION ON THE DISEASES.

During the war, practically as an emergency measure, some investigations were started on some of the important onion troubles. When the work was started, it was carried on jointly by the Department of Plant Pathology of the Experiment Stations, the Extension Division of the University and the U. S. Bureau of Entomology. D. C. Neal represented the Extension Division and T. H. Jones, the Bureau of Entomology. At the end of the first year the position of Extension Pathologist became vacant on account of the stoppage of the emergency appropriations. Also at that time the entomological department withdrew from the work because it was found that thrips had practically nothing to do with the onion seed failure. Consequently the work was turned over entirely to the Department of Plant Pathology of the Experiment Stations. While the emergency had passed and the interest in the onion diseases had declined, it was decided to continue the investigations long enough to finish up the lines of work that had been started.

Fig. 1. A row of seed onions in Lafourche parish affected with the black stalk rot disease.

The work was undertaken primarily to see if there was any possibility of controlling the diseases by spraying. It was also the aim of those in charge to find out as much as possible regarding the cause or causes of the diseases. No attempt was made at any time to make a study of the different organisms found on onion plants. The work was confined entirely to observations on the diseases as they occurred and to some preliminary control experiments. As there is no immediate possibility of continuing the investigations, it has been thought best to publish the observations and results.

Fig. 2. Seed onions affected with the black stalk rot disease.

APPEARANCE OF AFFECTED PLANTS.

The appearance of diseased seed onions in South Louisiana is very striking. The stems of the plants become covered with a black, smutty layer of spores and mycelium of the black stalk rot fungus. Many of the stems also rot off or become so weakened that they blow over with the least wind or even fall from their

own weight. In Fig. 1 is shown an infected onion field in South Louisiana and in Fig. 2, some of the infected plants. These pictures do not show an exaggerated condition but are typical of practically all of the onion patches in Lafourche, Terrebonne and adjoining parishes, and not only for one year but for every year. It is not uncommon to see half of the stalks broken off or bent to the ground. Practically all of the stalks, whether prostrate or standing, are covered with the black spore layer. Very few of the stalks which are broken or bent over produce much seed of value and the yield of the standing stalks is reduced to a considerable extent. Consequently, an estimate of fifty per cent loss is a moderate estimate of the damage caused by disease. Frequently it is considerably more than this.

WEATHER CONDITIONS.

The weather and climatic conditions seem to have a considerable bearing on the development of the onion diseases. This is shown by the difference in development of the onion troubles along Bayou Lafourche and at Baton Rouge, the two localities in which the investigations have been carried on. The lower part of Bayou Lafourche, where most of the onions are grown, is not far from the Gulf. The rainfall is heavy and humidity is high. Heavy fogs are very common during the early spring season. Furthermore, the soil is heavy and the drainage is not of the best. Baton Rouge is farther away from the Gulf and on higher ground. The fogs are not nearly as frequent and the humidity averages slightly lower.

FUNGI PRESENT ON ONION PLANTS.

There are a number of fungi present on the onion plants. While the exact importance of each has not been determined, it is evident that several of them play their part. The most common fungus present is *Macrosporium parasiticum*. Besides this, the following are frequently found: *Peronospora schleideniana, Colletotrichum circinans, Botrytis sp., Fusarium malli,* and another species of *Fusarium*. Besides these, a number of the ordinary saprophytic forms are frequently found on the old plants.

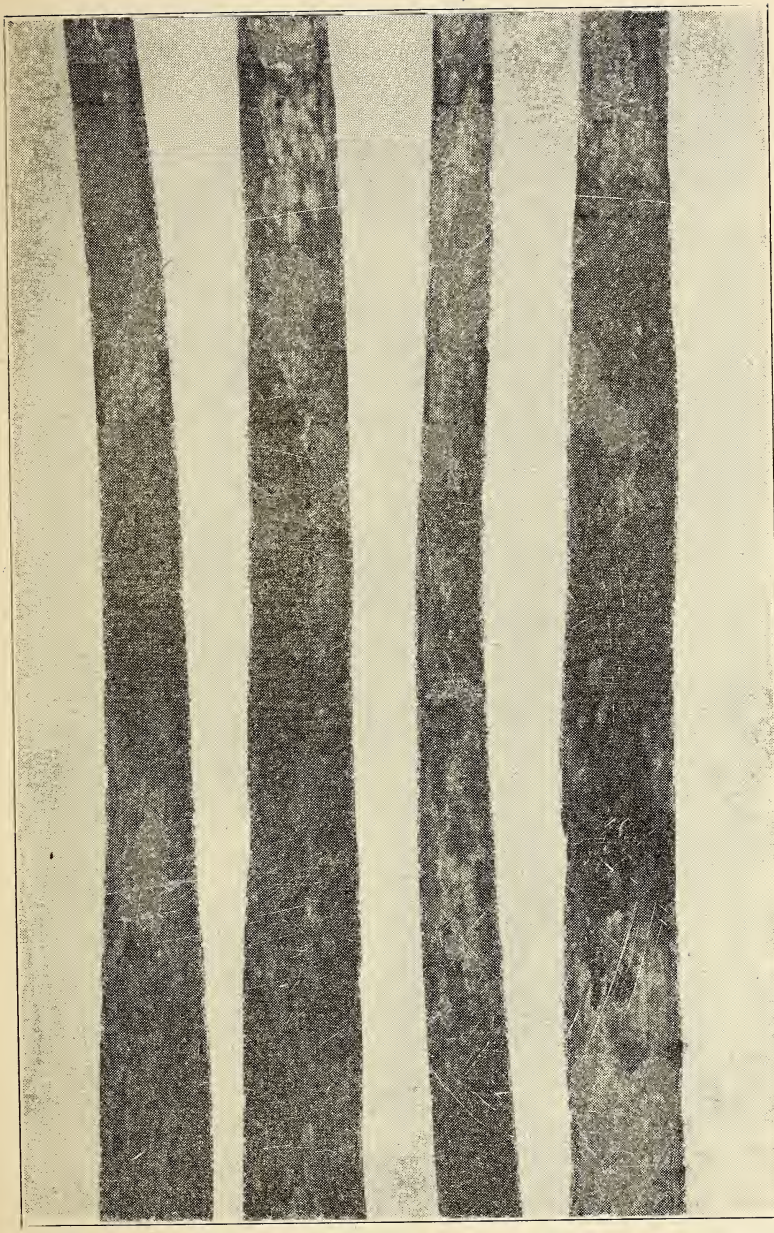

Fig. 3. Onion stalks affected with the black stalk rot disease. The black color is due to the presence of spores and mycelium of the causative fungus, *Macrosporium parasiticum*.

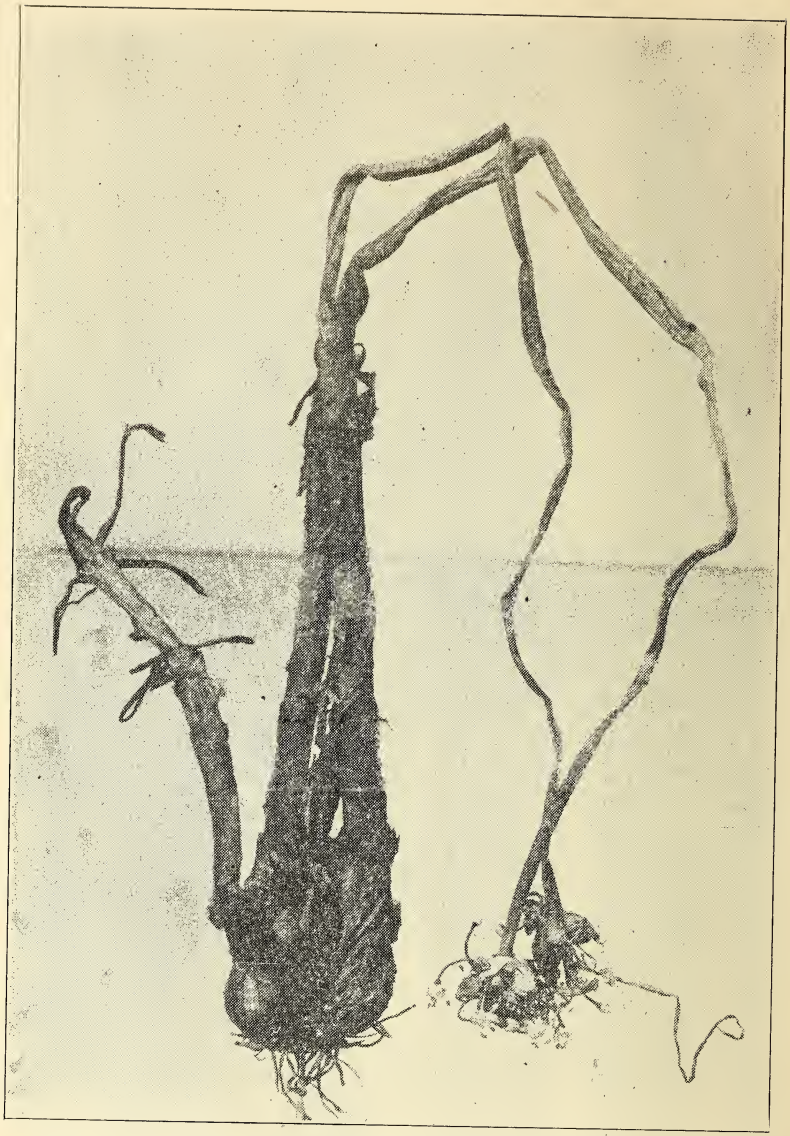

Fig. 4. An onion plant affected with the onion mildew, *Peronospora schleideniana.*

Macrosporium parasiticum is the fungus that gives the black color to the onion plants and is the cause of the black stalk rot disease (Fig. 3). All affected plants in South Louisiana are

covered with this fungus and it is practically the only fungus that is found on old plants. This fungus apparently develops better in the Bayou Lafourche region than it does on the higher land at Baton Rouge. A heavy development of this fungus was also seen at Hammond during the spring of 1921, following a severe infection of onion mildew. The black stalk rot disease is practically the only disease recognized by the onion growers.

Peronospora schleideniana is the fungus which causes the onion mildew (Fig. 4.). This disease is frequently common along Bayou Lafourche upon both bulb and seed crops and there is no question that it does considerable damage. In most cases, an outbreak of onion mildew is quickly followed by the black stalk rot. Such was the case at Hammond in 1921. The onion mildew has never been seen on the high land at Baton Rouge, although during three years bulbs were brought from the infested region along Bayou Lafourche and planted.

Colletotrichum circinans (Fig. 7.) is frequently found on onion plants but not abundant enough to do much damage. This fungus was frequently seen in the plantings at Baton Rouge, being more common there than along Bayou Lafourche. This was probably due to the fact that the decreased development of the *Macrosporium* gave it a chance to develop. This fungus is also commonly found on the bulbs, producing the disease known as the onion smudge.

A Botrytis species, probably the same one that is responsible for the neck rot disease in other onion sections, has been isolated a number of times from diseased stalks and from roots. However, it has not been abundant enough to seem of any economic importance.

The pink root disease, reported by Taubenhaus to be caused by the fungus, *Fusarium malli,* is quite common in various parts of Louisiana. It occurs both on the bulb and seed crops and is sometimes severe enough to injure them. This disease has been in the State for a long time, the Experiment Station having records of it since 1909. This disease, however, plays only a minor role in the deterioration of the seed crop.

There is also an onion root rot apparently caused by a species of Fusarium (Fig. 5). This fungus causes a rotting of the

roots and sometimes even causes a rot of the base of the stalk. This fungus causes a stunting of the plants and sometimes, partial sterility. Many of the flowers dry up without producing seed.

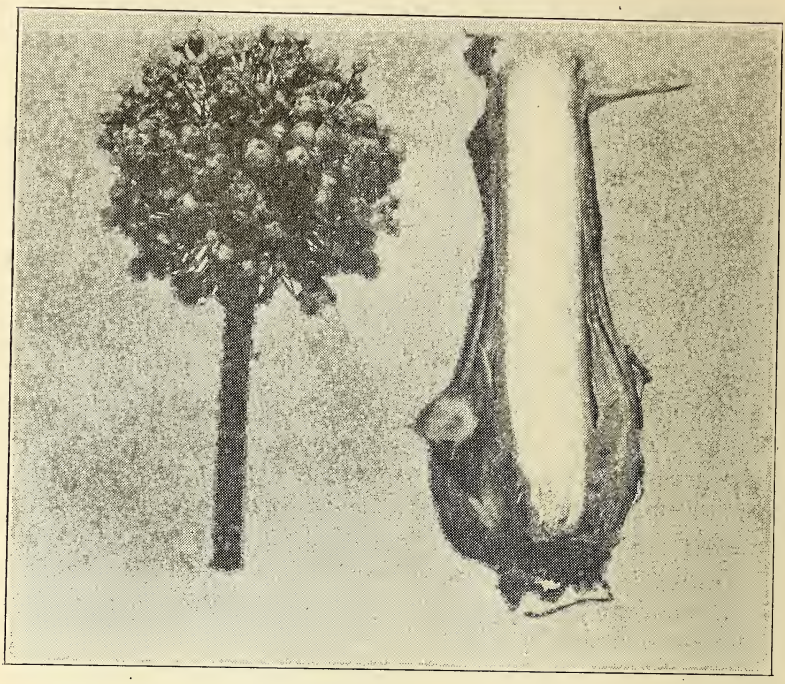

Fig. 5. Onion root rot. The roots and the base of the stalk rot and many of the flowers dry up without producing seed.

APPARENT DEVELOPMENT OF THE DISEASES.

While no inoculation or other life history experiments have been carried on with the various fungi found on onion plants, the general observations lead to several conclusions. It is evident that *Macrosporium parasiticum* is more parasitic than has been commonly believed. Under the right climatic conditions it will develop rapidly on any slightly weakened tissue and possibly will also attack the uninjured plant. There is no question that it spreads rapidly after it once gains entrance to the stalk. However, there is good evidence to show that the spread of the disease depends largely upon weather conditions. The spread

is much more rapid in the Bayou Lafourche region than it is at Baton Rouge. This is well shown by the two illustrations, Figs. 1 and 8.

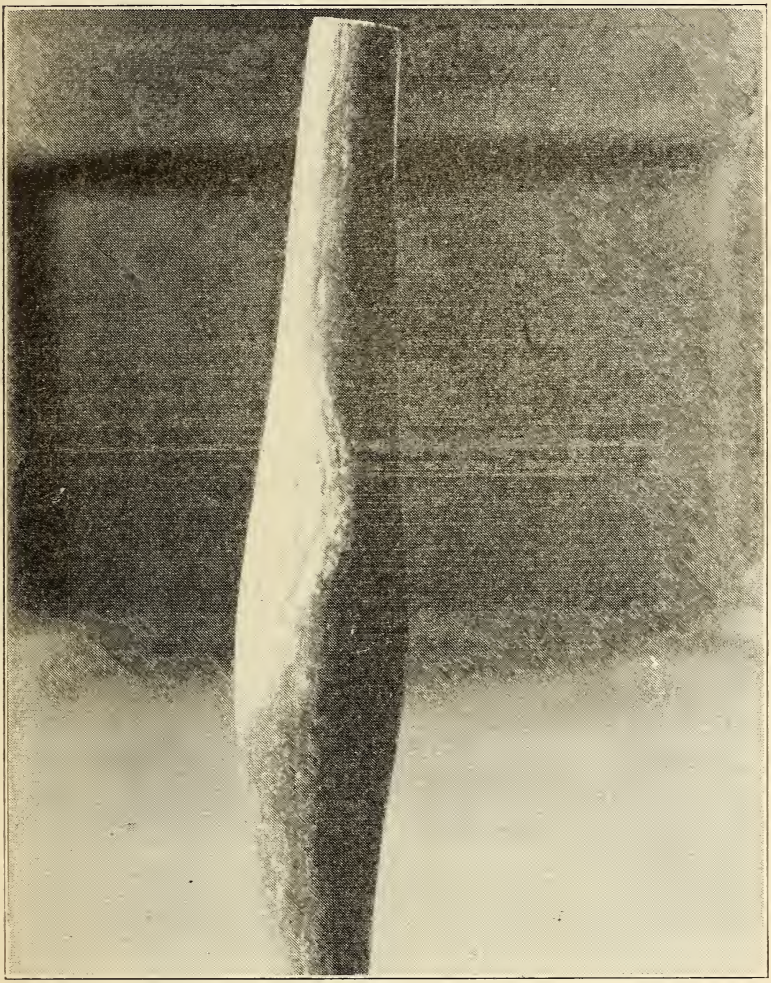

Fig. 6. An early stage of the white spot disease of seed onions.

There are two common troubles which seem to weaken the onion plants and make them more subject to the attack of the black stalk rot. These are the onion mildew and a white spot disease.

The cause of the latter has never been determined. Either or both of these commonly precede the black stalk rot disease, though this is not always the case.

The mildew is very common and frequently injures the plants very badly. Plants injured by the mildew are always overrun by the Macrosporium. In the literature on onion diseases it is generally assumed that the Macrosporium outbreaks follow attacks of the mildew. Yet under Louisiana conditions this is not always the case, as the black stalk rot is often common in fields in which no mildew can be found.

The white spot disease shows first in the form of chlorotic spots on the onion stem. These usually appear first on the enlarged portion of the stem, just above the surface of the ground. These spots (Fig. 6) are more or less circular, perfectly white in color and gradually increase in size. Cultures from these spots in the early stages have invariably given negative results, the cultures usually remaining sterile. It is possible that the cause of these spots is physiological. Soon after they show on the plants the spots easily become infected with the Macrosporium or some other fungus. In the Bayou Lafourche region this infection is nearly always the Macrosporium. At Baton Rouge, where the Macrosporium does not seem to spread so rapidly, other fungi such as *Colletotrichum circinans* and species of Fusarium are often found in these spots. In Fig. 7 are shown stems with the Colletotrichum.

CONTROL EXPERIMENTS

The first attempt in Louisiana to control the onion diseases by spraying was made by E. P. Barrios at Lockport, several years ago. He followed a tentative plan suggested to him by the Experiment Station. He sprayed the plants with Bordeaux mixture, spraying them very often, after practically every rain and heavy fog. In some weeks the plants were sprayed two or three times. This test was carried on in a year in which the diseases were very severe. He made a fair crop of onion seed and was one of the few growers that did. As he obtained a good price for the seed he was very well satisfied with the test.

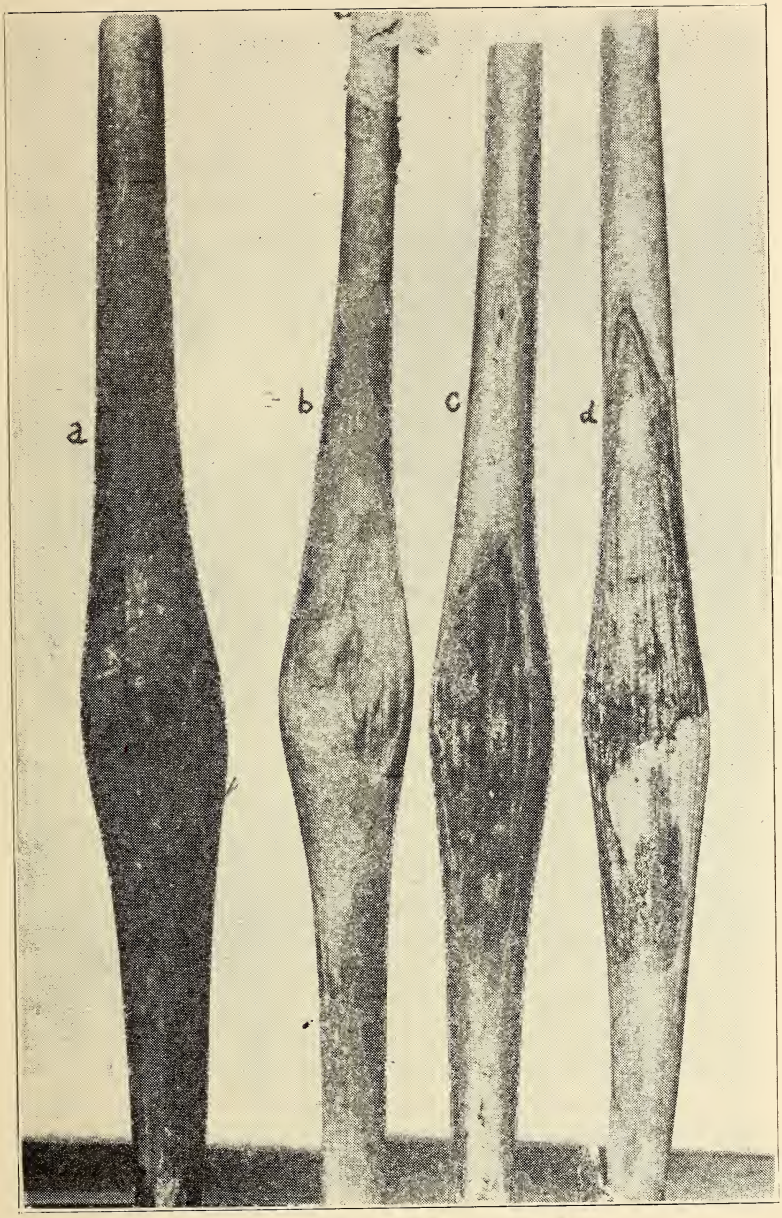

Fig. 7. Stages of the white spot disease.
(a) A healthy stalk; (b) A stalk with the spot becoming sunken, somewhat older than the spot shown in Fig. 6; (c) and (d) Stalks with old spots that have been overrun with *Colletotrichum circinans*.

In 1919, spraying tests were carried on cooperatively at Baton Rouge and Thibodaux by the Experiment Station and the United States Bureau of Entomology. Thibodaux is on Bayou Lafourche and is in the region where the growers have experienced the most difficulty in growing seed. The experiment at Baton Rouge was conducted in the Experiment Station garden, where it was possible to watch the plants carefully.

SPRAYING TESTS AT BATON ROUGE

For the spraying test at Baton Rouge, six rows of onions, 110 feet long, were set in the field in October 1918. The bulbs had been shipped in from Lafourche Parish, in order to introduce as far as possible, the diseases of that region. The onions were set in the field earlier than is the practice along Bayou Lafourche, but this seemed advisable on account of the slightly different weather conditions. The plants were beginning to send up seed stalks on February 13. During the winter and early spring beginning on January 29 and ending on May 1 these rows were sprayed with fungicides and insecticides.

The spray materials used were Bordeaux Mixture, distillate and nicotine sulphate (Blackleaf 40). These were used in various combinations. The Bordeaux Mixture was made at the 4-4-50 strength. The distillate, which was added as a sticker, was used at the rate of one part to the hundred. The Blackleaf 40, which was added to check thrips or other insects, was used at the rate of one part to the thousand. The different rows were sprayed as follows:

Row 1. Sprayed eleven times at weekly intervals with a combination of Bordeaux Mixture, distillate and Blackleaf 40, listed as Bordeaux-distillate-nicotine in the table below, first spraying on January 29 and last spraying on May 1.

Row 2. Left as a check, not sprayed.

Row 3. Sprayed nine times at weekly intervals with the Bordeaux-distillate-nicotine solution, first spraying on February 13 and last spraying on May 1.

Row 4. Sprayed like No. 3, except Bordeaux Mixture alone was used.

Row 5. Sprayed like No. 3 except a combination of Bordeaux Mixture and distillate, listed as Bordeaux-distillate in the table, was used.

Row 6. Sprayed like No. 3, except a combination of distillate and Blackleaf 40, listed as distillate-nicotine in the table, was used.

The solutions containing the distillate covered the plants better than the Bordeaux Mixture alone and were not as easily washed off by the rains. The plants were well covered with the spray mixtures at all times.

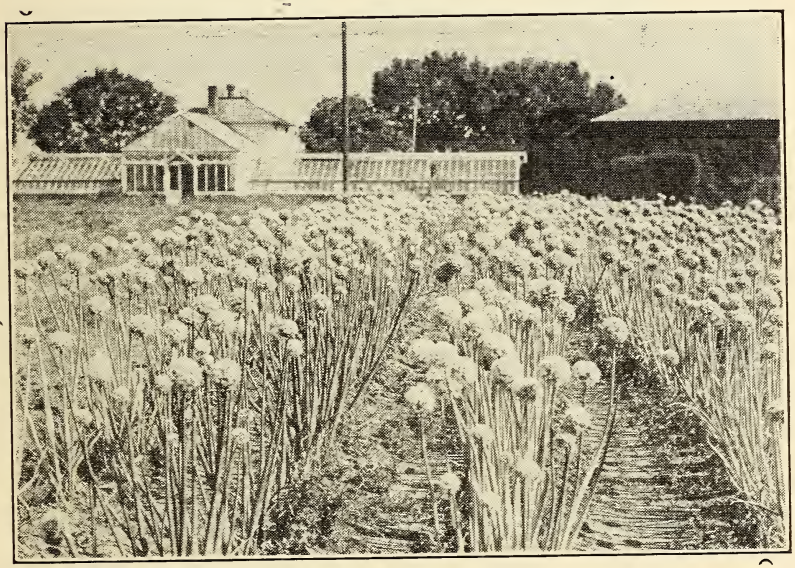

Fig. 8. The onion field used in the spraying test at Baton Rouge 1919. All plants remained remarkably free of disease.

All the plants remained remarkably healthy throughout the season (Fig. 8). There was a small amount of the Macrosporium, a little Botrytis and Fusarium injury and some Colletotrichum. Many of the plants had the white spots on them but these did not become seriously overrun with any of the fungi common in the Bayou Lafourche region. The seed were gathered as they ripened, during the latter part of May and the first of June. The results of the test are given below:

Table 1. Results of Onion Spraying Experiment, Baton Rouge, La., 1919.

Row No.	Treatment	Times Sprayed	Yield in Pounds of Seed Per Row
1	Bordeaux-distillate-nicotine	11	5.8
2	Check		4.6
3	Bordeaux-distillate-nicotine	9	6.7
4	Bordeaux	9	4.6
5	Bordeaux-distillate	9	5.9
6	Distillate-nicotine	9	4.8

The table shows an apparent gain in those rows that had both the Bordeaux Mixture and the distillate. But the test was not conclusive and it is doubtful if the spraying as it was carried on was a paying proposition.

SPRAYING TEST AT THIBODAUX

The spraying test at Thibodaux (Fig. 9) was on a row of onions about 440 feet long. This row was stepped off into five sections of practically equal length. The first of these sections was left as a check, while the others were sprayed with the same solutions as were used at Baton Rouge. The second section was sprayed with the Bordeaux-distillate-nicotine solution; the third with the Bordeaux-distillate solution; the fourth with the Bordeaux Mixture alone; and the fifth with the distillate-nicotine solution. The plants were sprayed on March 18, March 25, April 1, April 8, April 15, April 22, April 29, May 6, May 13 and May 20. The last spraying was about two weeks previous to the maturity of the plants.

On May 20, counts were made of the total number of stalks in each section and also of the number that had fallen over from disease, listed as *down stalks* in the table below.

In Table 2, are given the results of the spraying test. The table includes the total number of stalks, the number and percentage down on May 20, the actual yield of the different plots and the yields estimated to the same number of stalks that were

present in the check plot. When the stalks were counted, it was found that the check plot had a better stand than the rest and it seemed preferable to estimate the yield to the same number of stalks.

Fig. 9. The onion row used in the spraying test at Thibodaux, in 1919. In the foreground is shown one of the sprayed sections.

Table 2. Result of Onion Spraying Experiment, Thibodaux, La., 1919.

Plot	Treatment	No. of Stalks	No. of Down Stalks	Percent of Stalks Standing	Actual Yield in Pounds	Estimated Yield. (See Text)
1	Check	877	256	70.8	1.88	1.88
2	Bordeaux-distillate-nicotine	806	131	83.7	1.63	1.77
3	Bordeaux-distillate	796	151	81.0	2.13	2.34
4	Bordeaux	707	99	86.0	1.75	2.17
5	Distillate-nicotine	653	83	87.3	1.38	1.85

An examination of the table shows that all of the sprayed plots had a higher percentage of standing stalks but no definite conclusions can be drawn from the yields. It seems fairly certain that any extra yield that might have been obtained did not pay for the expense of spraying the plants ten times. It also seems probable that onion plants will have to be sprayed oftener than once a week in the Bayou Lafourche region, in order to protect them from the black stalk rot and other diseases.

GROWING SEED AT BATON ROUGE

Having had such good success with the onions that were grown at Baton Rouge in 1919, it was decided to continue the seed plots for at least two more years. The winter of 1918-1919 had been comparatively mild and there was a question whether the seed could be grown satisfactorily in a cold or even a normal winter. Unfortunately for the tests, the two following winters were also comparatively mild and there has been no opportunity to grow seed during one of the colder winters. However, the three winters of 1918-19, 1919-20 and 1920-21 were suitable for growing onion seed and good crops were obtained each season.

In 1919, the plot in seed onions, which was the same one as was used in the spraying experiments, covered one-twentieth of an acre; in 1920, it was about the same size; and in 1921, it was about one-thirteenth of an acre.

In 1919, the check row produced at the rate of 520 lbs. of seed to the acre, while the best sprayed plot produced 755 lbs. to the acre.

The 1920 crop was also planted with bulbs shipped in from Lafourche parish. There was very little disease on the plants throughout the season. The plot produced at the rate of 475 lbs. of seed to the acre.

In 1921, three different lots of bulbs were used for planting and these were planted on different dates. One lot had been grown at Baton Rouge from seed that had been produced in 1919 at Baton Rouge. These bulbs were sound but were comparatively small as they had been grown in a dry season. A second lot of the bulbs came from Lafourche parish. These were not very good as they had evidently been graded out at the time the crop

was sold in the spring. However, these were larger than the ones which had been grown at Baton Rouge. The third lot of seed bulbs came from Pointe Coupee parish. These were large and from outward appearances, the best of the three lots. The onions were planted on different dates to see if early or late planting would have any effect on the seed crop. There was but little of the Macrosporium on any of the plants but the rows planted from bulbs raised at Baton Rouge seemed to have more of the Fusarium root rot than the other rows. The yield from these different plots is shown in Table 3.

Table 3. Yield of Onion Seed at Baton Rouge in 1921.

Origin of Bulbs	Date Set in Field	Yield in Pounds per Acre
Baton Rouge	October 15	330
Baton Rouge	November 8	350
Lafourche	October 15	445
Lafourche	November 8	403
Pointe Coupee	November 17	635

The average yield of the whole acreage in 1921 was at the rate of 416 lbs. of seed to the acre.

In the spraying test at Thibodaux in 1919, the plot yielded at the rate of 283 lbs. to the acre, figuring on the same width of rows as was used at Baton Rouge. The onions in the test at Thibodaux compared well with any of the other fields in Lafourche parish, and it is doubtful if the average for that parish was as high as 250 lbs. to the acre.

From the tests, it is seen that the onions at Baton Rouge produced nearly twice as much seed as did those in Lafourche parish. This was unquestionably due to the fact that the plants at Baton Rouge were not seriously attacked by the diseases which are so troublesome in the Lafourche region, due, as it would seem, to the somewhat less rainfall and the lower humidity.

The Macrosporium was present at Baton Rouge but did not seem to spread very rapidly. None of the onion mildew was ever seen at Baton Rouge, although the bulbs from which

the seed was raised, were received from Lafourche parish where the mildew is present. It is possible that with an outbreak of mildew, no better results would be obtained at Baton Rouge than in Lafourche parish. Whether the mildew will develop on the high land at Baton Rouge as well as it does in the alluvial sections, is still a question.

These tests would seem to show that seedsmen would be more successful in producing seed for the market by having them grown outside the lower coast region. It would seem that the seed could be produced cheaper and that the crop would be as certain.

SUMMARY

1. In certain parts of Louisiana, especially along the lower coast in Lafourche and Terrebonne parishes, the onion seed crop is seriously reduced by diseases. These troubles usually reduce the crop about fifty per cent.

2. The principal organism present on the plants is *Macrosporium parasiticum*, but a number of other organisms are also present.

3. The Macrosporium follows the attack of the mildew and a white spot disease which is possibly physiological in nature. It is believed also that it attacks the uninjured plants when circumstances are right.

4. The disease causes the stalks to turn black and rot.

5. Spraying at weekly intervals has not given satisfactory results. To be effective, it is believed that spraying would have to be oftener.

6. Seed can be raised to better advantage away from the lower coast region, due to the greater freedom from disease. Tests at Baton Rouge have shown yields nearly twice as large as in Lafourche parish.